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ELECTROMAGNETIC WAVES ABSORBENT BODY AND ITS
MANUFACTURING METHOD, AND AN ELECTRONIC EQUIPMENT
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[Name of the Invention]

Electromagnetic waves absorbent body and its manufacturing method, and an electronic equipment

[Summary] (Corrections present)

[Assignment]

A film form electromagnetic waves absorbent body that is hard to burn and that has a high electromagnetic waves absorbency, and its manufacturing method.

[Solution Method]

The electromagnetic waves absorbent body has an electromagnetic waves absorbent layer 2 that has a soft magnetic body and a high polymer binder as the main body. The high polymer binder is over 25,000 on average in molecular weight, and the aromatic group component in the molecules is over 15 weight %. The manufacturing method is to form the electromagnetic waves absorbent layer by painting with a magnetic paint that contains a soft magnetic body and a high polymer binder as the main body onto a supporting body 1 and letting it dry.

[Area of Patent Requested]

[Requested Claim 1]

The electromagnetic waves absorbent body that is characterized by the following:
The electromagnetic waves absorbent body has an electromagnetic waves absorbent layer that has a soft magnetic particles and a high polymer binder as the main body. The previously mentioned high polymer binder is over 25,000 on average in molecular weight, and also the aromatic group component in the molecules is over 15 weight %.

[Requested Claim 2]

The electromagnetic waves absorbent body in the requested claim 1 that is characterized by the following: the previously mentioned electromagnetic waves absorbent layer also contains a phosphorus compound that is either liquid or solid.

[Requested Claim 3]

The electromagnetic waves absorbent body in the requested claim 2 that is characterized by the following: The amount of phosphorus in the previously mentioned phosphorus containing compound is over 0.25 weight parts in relation to 100 weight parts of the previously mentioned soft magnetic particles for a liquid phosphorus compound, and it is over 1.8 weight parts in relation to 100 weight parts of the previously mentioned soft magnetic particles for a solid phosphorus compound.

[Requested Claim 4]

The electromagnetic waves absorbent body in the requested claim 2 that is characterized by the following: It is difficult to burn and its characteristic meets V-0 of the UL-94 standard.

[Requested Claim 5]

The electromagnetic waves absorbent body in the requested claim 1 that is characterized by the following: the previously mentioned soft magnetic particles have an average particle diameter of over 0.2 μ m and under 100 μ m.

[Requested Claim 6]

The electromagnetic waves absorbent body in the requested claim 1 that is characterized by the following: the previously mentioned electromagnetic waves absorbent layer has a structure with multiple layers of laminated layers.

[Requested Claim 7]

A manufacturing method of the electromagnetic waves absorbent body that is characterized by the following: It is a manufacturing method that has a process of forming the electromagnetic waves absorbent layer that is made by a magnetic paint that has the soft magnetic particles and the high polymer binder as the main ingredient, and it is painted on the supporting body and dried. The previously mentioned high polymer binder has an average molecular weight of over 25,000, and the aromatic group component in the molecules is over 15 weight %.

[Requested Claim 8]

A manufacturing method of the electromagnetic waves absorbent body mentioned in the requested claim 7 that is characterized by the following: The above mentioned electromagnetic waves absorbent layer also contains a phosphorus compound that is either liquid or solid.

[Requested Claim 9]

A manufacturing method of the electromagnetic waves absorbent body mentioned in the requested claim 8 that is characterized by the following: The amount of phosphorus in the previously mentioned phosphorus containing compound is over 0.25 weight parts in relation to 100 weight parts of the previously mentioned soft magnetic particles for a

liquid phosphorus compound, and it is over 1.8 weight parts in relation to 100 weight parts of the previously mentioned soft magnetic particles for a solid phosphorus compound.

[Requested Claim 10]

A manufacturing method of the electromagnetic waves absorbent body mentioned in the requested claim 8 that is characterized by the following: It is difficult to burn and its characteristic meets V-0 of the UL-94 standard.

[Requested Claim 11]

A manufacturing method of the electromagnetic waves absorbent body mentioned in the requested claim 7 that is characterized by the following: the previously mentioned soft magnetic particles have an average particle diameter of over 0.2 μ m and under 100 μ m.

[Requested Claim 12]

A manufacturing method of the electromagnetic waves absorbent body mentioned in the requested claim 7 that is characterized by the following: the previously mentioned electromagnetic waves absorbent layer has a process of multiple layering with laminated layers.

[Requested Claim 13]

A manufacturing method of the electromagnetic waves absorbent body mentioned in the requested claim 7 that is characterized by the following: It has a process of peeling off the previously mentioned electromagnetic waves absorbent layer from the above mentioned supporting body, and a process of multiple layering of the laminated layers

between the multiple exposed surfaces on the above mentioned electromagnetic waves absorbent layer.

[Requested Claim 14]

An electronic equipment that is characterized by having the electromagnetic waves absorbent body mentioned in the requested claim 1.

[Detailed Explanation of the Invention]

[0001]

[The Technology Field the Invention Belongs]

This invention is regarding the electromagnetic waves absorbent body and its manufacturing method, and an electronic equipment. Specifically, it is regarding an electromagnetic waves absorbent body in film form that is hard to burn and that has a high electromagnetic waves absorbency, its manufacturing method, and an electronic equipment that uses it.

[0002]

[Previous Technology]

With the spreading of the cellular phones, personal computers, and all types of electronic equipments that have micro computers loaded on them, mutual interference of magnetic waves, interference, and malfunction, or stealing information by listening have become a technical and societal problem. As a strategy for these magnetic waves obstacles, the magnetic waves shielding material that uses electro conductive material, and electromagnetic absorbent bodies that use soft magnetic material have been used.

[0003]

The previously mentioned electromagnetic waves shielding material converts the electromagnetic waves energy into eddy current, and the intrusion of the electromagnetic waves inside an electronic equipment, and its radiation outside the electronic equipment is prevented. A method of covering with an electroconductive metallic membrane, or coating the electroconductive paint is used. However, there is an inconvenience in it that the electromagnetic waves that were sealed in tend to interfere within the equipment, and if the electronic equipment is not completely covered, the electromagnetic waves leak from miniscule gaps and the shield effect is decreased. If the gaps are completely sealed, on the other hand, the radiation of the electronic equipment decreases and other problems occur.

[0004]

For this reason, an electromagnetic waves absorbent body that decreases the reflective waves and the transmittance waves by absorbing the electromagnetic waves is getting attention. The electromagnetic waves absorbent body transforms the electromagnetic waves energy into heat energy by the soft magnetic material spinning inverted or through the movement of the magnetic wall, and the strength of the electromagnetic waves that are transmitted or reflected are decreased. The soft magnetic ferrite sintered body that is normally used as the electromagnetic absorbent body is heavy and fragile, making it difficult to process. Also, its electromagnetic waves absorbency drastically decreases in a high frequency area, limiting its application area.

[0005]

An electromagnetic wave absorbent body that disperses the electromagnetic waves absorbent material into matrixes such as resin and rubber and is molded into an electromagnetic wave absorbent body by a push out cast or a press cast is superior in its process tolerance, but it is difficult to load the electromagnetic waves absorbent material to make it highly dense. For this reason, it has been difficult to obtain a high electromagnetic waves absorbency characteristics. In addition, with the miniaturization and thinner forms of the electronic equipments in the recent years, a product that is thinner and lighter than the electromagnetic waves absorbent body that is also superior in the absorbency of the electromagnetic waves is in demand.

[0006]

In addition, the movement speed has accelerated, and the frequency that is being used is getting changed to high frequency waves, and the heat generation inside the electronic equipment has a tendency to increase. Therefore, not only heat resistance, but also the difficulty to burn is demanded from the electromagnetic waves absorbent body from the safety point.

[0007]

There is a method of using the high polymer binder that is difficult to burn as a presently available technology for assigning the difficulty to burn. This is a method that uses halogenated resin that is represented by polychlorinated vinyl resin and chlorinated polyethylene resin. Also, separately from the high polymer binder, there is a method of adding a halogen compound that is represented by bromine compound as the material that

is hard to burn. This halogenated resin and halogen type agent that is difficult to burn contain fireproof mechanisms that catch the radicals that are generated during the burning reaction by halogen and deactivate them. However, these halogen type compounds are going to be under review for their safety during heating and burning processes in the process of discarding them, and for their influence they have on the environment on the Earth.

[0008]

As a non-halogen type fire proof agent, on the other hand, there are fire proof agents such as metallic oxide compound types, bound water types, expanding types, and phosphorus types.

[0009]

As the examples for the metallic oxide compound types, antimony oxide molybdenum oxide, manganese oxide, chromium oxide, and iron oxide are indicated. It is common for these halogen type fire proof agents to be used as the assisting agents, and the fire proof effect is poor if used individually. Also from the point of view of heavy metal pollution, its usage will be limited globally.

[0010]

As the bound water types, there are compounds that contain a large amount of bound water such as aluminum hydroxide, magnesium hydroxide, and silica gel, and they are low in prices. However, in order to obtain the fire proof effect that is equivalent to the halogen type fire proof agents, a large amount at approximately 1- 2 times the weight of the target product needs to be mixed in, which lowers the weight ratio of the soft

magnetic particles, sometimes leading to a decrease in the actual characteristics of the electromagnetic waves absorbent body.

[0011]

An expanding fire proof agent works in the opposite way where it burns itself quickly and its volume quickly expands, and the prevention of the spreading of fire is expected from the insulating effect and the oxygen shielding effect. However, it is unsuitable for the goal of preventing the initial burning of the electromagnetic waves absorbing body itself.

[0012]

Therefore, none of the fire proof high polymer binders or the fire proof agents were sufficient for the use in the electromagnetic wave absorbent body of the next generation.

[0013]

[The Assignment the Invention is Trying to Solve]

This invention is proposed while considering these circumstances, and its assignment is to offer an electromagnetic waves absorbent body that is thin and light in weight, flexible and superior in its mechanical strength, while also being superior in its fire proof characteristic, and is highly absorbent, and to offer its manufacturing method, and an electronic equipment that is equipped with it.

[0014]

[Method of Solving the Assignment]

The electromagnetic waves absorbent body in this invention is characterized by the fact that it is an electromagnetic waves absorbent body that has the electromagnetic

waves absorbent layer with the soft magnetic particles and high polymer binder as the main body. The high polymer binder is an average molecular weight of over 25,000, and the aromatic group component in the molecules is over 15 weight %.

[0015]

Also, the manufacturing method of the electromagnetic waves absorbent body in this invention is characterized by the following: The manufacturing method of the electromagnetic waves absorbent body has a process of forming the electromagnetic waves absorbent layer by painting the magnetic paint that has the soft magnetic particles and the high polymer binder as the main body onto the supporting body, and drying it. This high polymer binder is over 25,000 on average in molecular weight, and the aromatic group component in the molecules is over 15 weight %.

[0016]

Although there is no upper limit to the average weight amount of the high polymer binder, the ability to dissolve and the viscosity of the paint is naturally limited during the adjustment of the magnetic paint, and normally, approximately under a few hundred thousand is selected.

[0017]

It is even more preferred to have over 20 weight % of the aromatic group component in the molecules in the high polymer binder in any of the invention. There is no specific upper limit to the amount of the aromatic group component contained, and this also is a design time that is determined by the ability to dissolve and the viscosity of the paint during the adjustment of the magnetic paint, or the degree of flexibility of the

electromagnetic wave absorbent layer, and normally, an item under approximately 10's to 90's in weight % is selected.

[0018]

It is desirable to have the amount of the high polymer binder contained over 5 weight part and under 12 weight part in relation to the 100 weight part of soft magnetic particles. It is brittle if the weight does not reach 5 weight part and the mechanical strength cannot be obtained, and if it is over 12 weight part, the matrix component becomes excessive, and the loading density of the soft magnetic particles decreases.

[0019]

The electromagnetic wave absorbent layer is preferred to also have a liquid or a solid phosphorus compound. In order to attach the fire proof characteristic for certain, the amount of phosphorus in the phosphoric compound is preferred to be over 0.25 weight parts in relation to 100 weight parts of the soft magnetic particles if the phosphorus compound is liquid. If the phosphorus compound is a solid compound, it is preferred to have over 1.8 weight part in relation to the 100 weight part of the soft magnetic particles. The upper limit of the amount of the phosphorus in the phosphorus compound depends on the molecular structure of the high polymer binders that are used together, but from the safety point of view, the one with under a few % is selected.

[0020]

The average diameter of the soft magnetic particles that are used in this invention is over 0.2 μ m and under 100 μ m, and preferably under 30 μ m. Although the loading density goes up at under 0.2 μ m, the contraction after the electromagnetic wave absorbent layer dries is great, the form of the electromagnetic wave absorbent body worsens, and

cracks can be easily generated. At over 100 μ m, the ability to load the soft magnetic particles is lowered, and the worsening of the electromagnetic waves absorbency is seen, as well as the worsening of the physicality of the membrane to be painted. In addition, if a lot of the particles that are over 100 μ m are included, the surface roughness of the electromagnetic wave absorbent layer increases, and not only does it cause an impediment in the laminating process, but also it lowers the mechanical strength of the electromagnetic waves absorbent layer.

[0021]

The electromagnetic waves absorbent body in this invention can have the electromagnetic waves absorbent layer peeled of the supporting body, and used as an individual unit of the electromagnetic waves absorbent layer. Also, the electromagnetic waves absorbent body in this invention can have the electromagnetic waves absorbent layer laminated into multiple layers. In this case, it can be laminated together with the supporting, or the electromagnetic waves absorbent layer can be peeled off the supporting body and only the electromagnetic waves absorbent layer can be laminated as well. If it is laminated together with the supporting body, it is preferred for the supporting body to have its own fire proof characteristic.

[0022]

The electronic equipment in this invention is characterized by being equipped with the electromagnetic waves absorbent body that is related to the invention.

[0023]

[Operation]

By choosing to have the average weight of the molecules of the high polymer binder to be over 25,000, the heat resistance is increased, while it is also easy to form a carbon capsule on the surface in the initial stages even if it turns into a burning situation, and a self-burning stop effect can be easily obtained. This fire proof characteristic and the self-burning stop effect is further improved by having over 15 weight % of the aromatic group component in the molecules, or preferably over 20 weight %.

[0024]

The phosphorus type fire proof agent prefers to take away the oxygen during burning or when the burning begins. A carbon capsule is formed on the surface of the high polymer binder, and a suffocation effect is obtained by blocking the oxygen. Since the fire proof effect that is attached does not reach that of the halogen type fire proof agent, it is necessary to select a high polymer binder. In this invention, attaching a high fire proof characteristic becomes possible by using together the high polymer binder with a specific structure as mentioned above.

[0025]

As for the phosphorus type fire proof agent, single phosphorus unit such as red phosphorus, etc, or a substance that contains a high ratio of phosphorus atom will obtain a great fire proof effect. However, from the point of view of safety on the opposite side, it is preferable to use the phosphoric compounds such as phosphoric acid ester or phosphoric acid ammonium.

[0026]

[Execution Form of the Invention]

Below is a detailed explanation of the electromagnetic waves absorbent body in this invention with references to figures.

[0027]

The basic structure of the electromagnetic waves absorbent body in this invention is indicated in the outline section in Figure 1. In there, Figure 1 (a) is the electromagnetic waves absorbent layer 2 that was formed on top of the supporting body 1. Figure 1 (b) is the electromagnetic waves absorbent body that was constructed from the electromagnetic waves absorbent layer only after separating the two by peeling.

[0028]

An example of the electromagnetic waves absorbent body in this invention constructed on the laminated layer is indicated in Figure 2. The lamination can be done using anything from the adhesive glue, pressure sensitive adhesive, or a heating crimp. Out of these, the Figure 2 (a) ~ (c) are the electromagnetic waves absorbent body with a structure in the Figure 1 (a) that was laminated after the inside and the outside were flipped and the directions changed. Figure 2 (d) is the supporting body 1 that was additionally laminated on the electromagnetic waves absorbent layer 2 side of the electromagnetic waves absorbent body with a structure in the Figure 1 (a). Figure 2 (e) is the electromagnetic waves absorbent body in Figure 2 (d) that was additionally laminated.

[0029]

Figure 2 (f) is the electromagnetic waves supporting layer 2 that was additionally laminated on the electromagnetic waves absorbent layer 2 side of the electromagnetic waves absorbent body in Figure 1 (a). The electromagnetic waves absorbent body in Figure 2 (f) can be manufactured by repeating the painting and drying of the electromagnetic waves absorbent layer 2 twice. Or, the electromagnetic waves absorbent body with the structure in Figure 1 (b) can be laminated to the electromagnetic waves absorbent body with the structure in Figure 1 (a). The direction of the lamination layer, other than the structure in Figure 2 (f), can be set by setting the electromagnetic waves absorbent layer 2 on both surfaces of the supporting body 1.

[0030]

Figure 2 (g) is the electromagnetic waves absorbent body with the structure in Figure 1 (b) that was laminated for 2 layers. Also, Figure 2 (h) is the electromagnetic waves absorbent body with the structure in Figure 1 (b) that was laminated for n layers. By multiply layering this way, the electromagnetic waves absorbency improves.

[0031]

As for the supporting body 1, paper, high polymer resin, cloth, non-woven fabric, metal, glass, etc, is used with the high polymer resin such as paper and polyolefine laminated on it. Out of these, the high polymer resin that is thin and strong is preferred to be used. If the electromagnetic waves absorbent layer is peeled off, the supporting body that has the ability to be peeled off is preferred to be used.

[0032]

There is no specific restriction for the high polymer resin for the supporting body, but the following are indicated as the examples: polyester types such as polyethylene terephthalate, polyethylene – 2, 6 – naphthalate, etc, polyolefine types such as polyethylene, and polypropylene, etc, fluoridated resin that replaced a part of or the entire hydrogen in the polyolefine types with fluoride, cellulose derivatives such as cellulose triacetate, cellulose diacetate, etc, vinyl type resins such as poly chloride vinyl, etc, vinylidene resin such as poly chloride vinylidene, poly carbonate, poly phenylene sulfide, polyamido-imide, polyimide, etc. The surface of these high polymer resins can have a peeling process using a mold releasing agent such as a silicon resin. These high polymer resins are preferred to be a board form or a film form. If it is a board form, the thickness is preferred to be approximately a few hundred μm to a few mm, and a few μm to a few hundred μm if it is a film form. Also, the box of the electronic equipment can be used as the supporting body.

[0033]

The soft magnetic particle material that is used for the electromagnetic waves absorbent layer is not specifically limited. Examples are indicated as the following: metallic soft magnetic material such as FeSi, FeNi, FeSiAl, etc, and oxidized soft magnetic material, etc, such as MnZn ferrite, MgZn ferrite, and NiZn ferrite. The preferred average diameter of these soft magnetic particles is as mentioned earlier.

[0034]

The high polymer binder that is used in the electromagnetic waves absorbent layer is not specifically limited either. Any one out of thermoplastic resin, heat hardening resin, and the reactive resin can be used, and the one with an average molecular weight of over 25,000 is selected.

[0035]

For the thermoplastic resin, for example, the following can be mentioned: acetic acid vinyl resin, fluoridated vinyl resin, acrylic acid ester – acryl nitril copolymer, metacrylic acid ester – ethylene copolymer, acrylonitrile – butadiene copolymer, styrene – butadiene copolymer, polyurethane resin, polyester polyurethane resin, polyester resin, polycarbonate polyurethane resin, polycarbonate resin, polyamide resin, poly vinyl butyral resin, cellulose derivatives (cellulose acetate butylate, cellulose diacetate, cellulose triacetate, cellulose propionate, nitro cellulose, etc), styrene butadiene copolymer, amino resin, polyphenylene sulfide resin, and all types of synthetic rubber types. Either way, the one that does not contain the halogen element is preferred to be selected.

[0036]

Also, for the example of the heat hardening resin and the reactive type resin, the following are mentioned as the examples: phenol resin, epoxy resin, polyurethane hardening type resin, uric formaldehyde resin, melamine resin, alkyd resin, silicone resin, polyamine resin, a mixed compound of high molecular weight polyester resin and isocyanate prepolymer, a mixed compound of polyester polyol and polyisocyanate, a

mixed compound of low molecular weight glycol and high molecular weight diol and isocyanate, and a mixture of these resins. Out of these resins, it is preferred to use polyurethane resin, polycarbonate resin, polyester resin, and acrylonitrile – butadiene copolymer that add flexibility.

[0037]

In order to increase the dispersing of the soft magnetic particles in these resins, it is preferable that these resins contain polar functional groups such as $-\text{SO}_3\text{M}$, $-\text{OSO}_3\text{M}$, $-\text{COOM}$, or $-\text{PO}(\text{OM}')_2$, etc. (However, M indicates an alkaline metal such as H or Li, Ka, Na, etc, and M' indicates an alkaline metal or an alkyl group such as H, Li, Ka, Na, etc). As the polar functional groups, there are side chain types that have a terminal group of $-\text{NR}_1\text{R}_2$, $-\text{NR}_1\text{R}_2\text{R}_3^+\text{X}^-$, and $>\text{NR}_1\text{R}_2^+\text{X}^-$ with main chains other than what have already been mentioned. (Here, R_1 , R_2 , and R_3 are hydrogen atoms or hydrocarbon group, X^- indicates a halogen ion such as fluoride, bromine, and iodine, or inorganic or organic ions). Other than those, polar functional groups can be $-\text{OH}$, $-\text{SH}$, $-\text{CN}$, and epoxy group etc. The amount of these polar functional groups contained is $10^{-1} \sim 10^{-8}$ mol/g, and preferably $10^{-2} \sim 10^{-6}$ mol/g. These organic binders can be used individually or more than 2 types can be used together.

[0038]

Out of the high polymer binders mentioned above, polyisocyanate can be added as a hardening agent that hardens the cross-link of the hardening resin, for example. Trimethylol propane, and an adduct (for example product name Coronate L-50) of 2, 4 – tolulene di isocyanate (TDI) is common for polyisocyanate, but adducts to alkylene di isocyanate such as 4, 4 – di phenyl methane di isocyanate (MDI) and hexane di

isocyanate (HDI) can be used as well. Other than that, any of the previously well known compounds such as poly glycidyl amine compounds such as tetra glycidyl metaxylene di amine, tetra glycidyl - 1, 3 - bis amino methyl cyclo hexane, tetra glycidyl amino di phenyl methane, and tri glycidyl - p - amino phenol, etc, polythiol compounds such as 2 - di butyl amino - 4, 6 - di mercapto replaced triazine, epoxy compounds such as tri glycidyl isocyanurate, a mixed compound of epoxy compound and isocyanate compound, a mixed compound of epoxy compound and oxazoline compound, a mixed compound of imidazole compound and isocyanate compound, non-aqueous methyl “nadine acid??,” etc. The mixing ratio of these hardening agents into the hardening resins is 0.5 ~ 80 weight parts in relation to 100 weight parts of the hardening type resin, and preferably 5 ~ 50 weight parts. By adding the hardening agent within this range, the avidity between the pigment such as the soft magnetic particles and the binder increases, and the mechanical strength of the electromagnetic waves absorbent layer improves. These isocyanate compounds can be painted on the surface of the painted membrane on the electromagnetic waves absorbent layer. In this case, the area near the surface of the electromagnetic waves absorbent layer hardens as the main body, and the falling off of the pigments such as the soft magnetic particles and the high polymer binder from the electromagnetic waves absorbent layer is prevented.

[0039]

With either of these high polymer binders, the ones with over 15 weight % of the aromatic group component in the molecules are preferred, and the ones with over 20 weight % are even more preferred. The ones that do not have the aromatic group

component in the molecules can be blended with other high polymer binders that have the aromatic groups to reach this value.

[0040]

The electromagnetic waves absorbent body in this invention can contain an organic silane compound in the electromagnetic waves absorbent layer. The organic silane compound strengthens the reinforcing effect between the soft magnetic particles and the high polymer binder interface, and the mechanical strength of the electromagnetic waves absorbent layer is strengthened. The following are examples of the organic silane compounds, but it is not limited to these compounds: vinyl trichloro silane, vinyl tris (β - methoxy ethoxy) silane, vinyl tri ethoxy silane, vinyl tri methoxy silane, γ - metacryloxy propyl tri methoxy silane, γ - metacryloxy propyl ethoxy silane, β - (3, 4 epoxy cyclo hexyl) ethyl tri methoxy silane, γ - glycidoxy propyl tri methoxy silane, γ - glycidoxy propyl methyl di ethoxy silane, N - β - (amino ethyl) γ - amino propyl tri methoxy silane, N - β - (amino ethyl) γ - amino propyl methyl di methoxy silane, γ - amino propyl tri ethoxy silane, γ - amino propyl tri methoxy silane, N - phenyl - γ - amino propyl tri methoxy silane, γ - mercapto propyl tri methoxy silane, γ - chloro propyl tri methoxy silane.

[0041]

A lubricating agent, reinforcing pigment, conductive particles, antistatic agent, surfactant, stabilizer, and other additives can be used for the electromagnetic waves absorbent layer as needed. Previously available general material and the mixing ratios can be used for these additives.

[0042]

For the lubricating agent, any of the previously well known compounds such as graphite, double sulphurated molybdenum, double sulphurated tungsten, fatty acid with the number of carbons of approximately 2 to 26, and a fatty acid ester that is made of these fatty acids and alcohol that has the number of carbons of approximately 2 to 26, terpene type compounds, and their oligomers, silicone oil, fluoridated lubricants, etc, can be used.

[0043]

The examples for the reinforcing pigments are inorganic pigments such as silicone oxide, aluminum oxide, calcium carbonate, carbon fiber, glass fiber, etc. The amount of the reinforcing pigments to be added is under 20 weight parts in relation to 100 weight parts of the soft magnetic particles, or preferably under 10 weight parts.

[0044]

For the conductive particles and the antistatic agent, the electro conductive oxidized compounds such as carbon black, graphite, metallic particles, stannic oxide, ITO (Indium Tin Oxide), etc, or surfactant agents are used.

[0045]

For the surfactants, previously well known nonion types, cation types, anion types or any one with both polarities can be used.

[0046]

There are no specific limitations to the solvent for adjusting the paint that contains the above mentioned soft magnetic particles, the high polymer binder, and the organic

silane compound as the main body, and the following can be used: ketone types such as acetone, methyl ethyl ketone, methyl isobutyl ketone, cyclo hexanone, etc, and alcohol types such as methanol, ethanol, propanol, butanol, and ester types such as acetic acid methyl, acetic acid ethyl, acetic acid propyl, acetic acid butyl, lactic acid ethyl, ethylene glycol acetate, and ether types such as di ethylene glycol di methyl ether, 2 – ethoxy ethanol, tetra hydro furan, dioxane, and aromatic group hydrocarbon type compound such as benzene, toluene, xylene, and halogenated hydrocarbon type compound such as methylene chloride, ethylene chloride, carbon tetrachloride, chloroform, and chloro benzene.

[0047]

For the mixing equipment and for the dispersing for the adjustment of paint, kneader, agitator, bowl mill, sand mill, roll mill, extruder, homogenizer, and the ultrasonic waves dispersing equipment are used, but it is not limited to these.

[0048]

The method of painting for the formation of the electromagnetic waves absorbent layer on the supporting body is not specifically limited either, and any previously available methods can be used such as the air doctor coat, blade coat, wire bar coat, air knife coat, squeeze coat, impregnation coat, reverse role coat, transfer role coat, gravure coat, kiss coat, cast coat, extrusion coat, dye coat, spin coat, etc. By using the painting equipment for these methods, one side or both sides of the supporting body can be painted.

[0049]

Also, as indicated in Figure 2 (f), when forming multiple layers of the electromagnetic waves absorbent layer 2 on one side of the supporting body 1, a dye coater, etc, that has numerous lips is used, and a simultaneous multilayered painting can be done. After painting the electromagnetic waves absorbent layer onto the supporting body, if is dried with heated air, etc, and the organic solvent is removed. A hardening process is applied as necessary, and an additional electromagnetic waves absorbent layer can be painted and formed as the top layer.

[0050]

For the lamination method of the electromagnetic waves absorbent body, formation using increasing pressure mold, increasing pressure thermoforming, adhesives, and pressure sensitive adhesives is adopted. The conditions for increasing pressure is the type of binders, the presence or absence of heat, heat temperature, and although it depends on the number of sheets of the electromagnetic waves absorbent body and the thickness, generally the surface pressure of $0.1 \sim 500 \text{ kg/cm}^2$ is selected. For the heat molding, under 250°C is preferred. For the increasing pressure molding and the increasing pressure thermoforming, regular press equipment and roll laminator, etc, are used.

[0051]

The same formation method is used when the electromagnetic waves absorbent layer that was formed on top of the supporting body is peeled off and the peeled off electromagnetic waves absorbent layer is laminated.

[0052]

The adjustment of the paint for the electromagnetic waves absorbent layer is done through each process of mixing, dispersing, and kneading the soft magnetic particles, and other additives, binders, and organic solvents as needed.

[0053]

[Execution Examples]

An ideal execution example of this invention is explained in details below using comparison examples as necessary. However, these execution examples are only examples, and this invention is not limited to them.

[0054]

[Execution Example 1]

For the soft magnetic particles, MgZn ferrite with the characteristics mentioned below was used.

<Soft magnetic particles characteristics>

Fe/ Mg/ Zn composition 100/18, 4/12 atm%

Average particle size 7.2 μm

Remainder from sifting (over 100 μm) under 0.1%

Decrease in weight from drying 0.25%

Coercive force 1.19 kA/m (15 Oe)

[0055]

The composition of the soft magnetic particles is analyzed using an X ray diffraction equipment (made by Rigaku Electronics Co.) by the fluorescent X ray method. The amount of each atoms contained is indicated with a relative ratio when the amount of

Fe atoms contained is 100. The average particle diameter was observed using the transmission electron microscope (made by Nihon Denshi Co.) and the average value of the particle diameter for individual particle was used for 500 soft magnetic particles that were randomly selected. For the remainder from sifting, a mesh size sift of 100 μm was used, and the weight of the remainder after sifting forcibly with flowing pure water was weighed. The decrease in weight from drying was indicated after keeping them in a heating furnace at 150°C for 60 minutes. The coercive force was measured by the sample oscillation type magnetic fluxometer.

[0056]

(Adjustment of the paint for the electromagnetic waves absorbent layer) These soft magnetic particles were mixed with polyurethane resin (high polymer binder A: average molecular weight 30,000, the aromatic group component in the molecules is 22 weight %) that is the high polymer binder, and a liquid phosphoric acid ester oil (10 weight % of phosphorus atoms contained in the phosphoric compound) that is the phosphoric compound in a bowl mill, evenly distributed, and made into paint. The composition of the paint for the electromagnetic waves absorbent layer is indicated below.

MgZn Ferrite particles	100 weight parts
Polyurethane resin A	10 weight parts
Phosphoric acid ester oil	4 weight parts
Methyl ethyl ketone	30 weight parts
Toluene	10 weight parts

0.5 weight parts of polyisocyanate (Coronate HL made by Japan Polyurethane Co.) was added to the compound that was made into paint right before painting, and mixed, and this was made into the paint for the electromagnetic waves absorbent layer.

[0057]

(Formation of the electromagnetic waves absorbent layer)

As one example, the paint for the electromagnetic waves absorbent layer was painted with a knife coater onto one main surface of the supporting body with a thickness of 50 μm that was made from polypropylene film. It was set so that the application thickness is 0.7mm while it is moist, and it becomes 0.25mm after it dries. The electromagnetic waves absorbent layer was formed after going through each process of hardening and drying for 20 hours at 60°C. The density of the phosphorus atoms in this electromagnetic waves absorbent layer is 0.4 weight parts in relation to 100 weight parts of soft magnetic particles. The electromagnetic waves absorbent body indicated in Figure 1 (a) is formed by cutting this to an appropriate shape.

[0058]

(Manufacturing of the electromagnetic waves absorbent body with a laminated structure)

In this execution example, 2 sheets of the electromagnetic waves absorbent body that are indicated in Figure 1 (a) were prepared in order to improve the absorbency characteristic of the electromagnetic waves. These electromagnetic waves absorbent layers were put to face each other and were put through a laminator continuously and crimped by heat. The crimping condition is 150°C and 10 kg/cm of line pressure. Next, the supporting body on one side was peeled off, and the exposed surfaces of the electromagnetic waves absorbent layer are put to face each other and continuously put through a laminator, crimped by

heat, and made into 4 layers of laminated structure. Then, one side of the supporting body is peeled off, and the exposed surfaces of the electromagnetic waves absorbent layer are put to face each other and continuously put through a laminator, crimped by heat, and made into 8 layers of laminated structure. After this, both sides of the supporting body are peeled off, and the electromagnetic waves absorbent body in the execution example 1 that is made of a laminated structure of individual electromagnetic waves absorbent layer with a thickness of 2.0 mm is complete. This is a n=8 laminated structure body in Figure 2 (h). The volume opposition rate in this execution example 1 was $1.0 \times 10^8 \Omega$.

[0059]

The electromagnetic waves absorbent characteristic of the electromagnetic waves absorbent body was evaluated by measuring the neighboring electric field shield effect, using the cells that Kansai Denshi Industries Shinkou Center promotes. The measurement results will be mentioned later.

[0060]

[Execution Example 2]

MgZn ferrite with the same composition as in the execution example 1 and the same phosphorus compound were used in the same amount (4 weight parts in relation to 100 weight parts of the soft magnetic particles). For the high polymer binder, on the other hand, other than using the polyurethane resin (high polymer binder B) with the aromatic group component density of 15 weight % in the molecules with an average molecular weight of 30,000, the electromagnetic waves absorbent body of the execution example 2 that is made of 8 layers of laminated structure of the electromagnetic waves absorbent layer as in the execution example 1 was obtained. The density of the phosphorus atoms

in the electromagnetic waves absorbent layer was also 0.4 weight parts in relation to 100 weight parts of soft magnetic particles.

[0061]

[Execution Example 3]

Other than changing the amount of the phosphorus compound added to 3 weight parts in relation to 100 weight parts of soft magnetic particles, the electromagnetic waves absorbent body of the previous execution example 2 that is made of 8 layers of laminated structure of the electromagnetic waves absorbent layer of the execution example 3 was obtained. The density of the phosphorus atoms in the electromagnetic waves absorbent layer was also 0.3 weight parts in relation to 100 weight parts of soft magnetic particles.

[0062]

[Execution Example 4]

Other than changing the phosphorus compound that is the fire proof agent to a solid poly phosphoric acid ammonium chloride, and changing the amount to be added to 7 weight parts in relation to 100 weight parts of soft magnetic particles, the electromagnetic waves absorbent body of the previous execution example 2 that is made of 8 layers of laminated structure of the electromagnetic waves absorbent layer of the execution example 4 was obtained. The amount of the phosphorus atoms contained in poly phosphoric acid ammonium is 30 weight %. Therefore, the density of the phosphorus atoms in the electromagnetic waves absorbent layer is 2.1 weight parts in relation to 100 weight parts of soft magnetic particles.

[0063]

[Execution Example 5]

Other than changing the phosphorus compound that is the fire proof agent to a solid poly phosphoric acid ammonium chloride that is the same as in the execution example 4, and changing the amount to be added to 6 weight parts in relation to 100 weight parts of soft magnetic particles, the electromagnetic waves absorbent body of the previous execution example 2 that is made of 8 layers of laminated structure of the electromagnetic waves absorbent layer of the execution example 5 was obtained. The density of the phosphorus atoms in the electromagnetic waves absorbent layer is 1.8 weight parts in relation to 100 weight parts of soft magnetic particles.

[0064]

[Reference Example 1]

Other than changing the amount of phosphorus compound to be added to 2 weight parts in relation to 100 weight parts of soft magnetic particles, the electromagnetic waves absorbent body of the previous execution example 2 that is made of 8 layers of laminated structure of the electromagnetic waves absorbent layer of the reference example 1 was obtained. The density of the phosphorus atoms in the electromagnetic waves absorbent layer in the reference example 1 is 0.2 weight parts in relation to 100 weight parts of soft magnetic particles, which is less than the preferred density of the liquid phosphorus compound. The execution example 2, execution example 3, and the reference example 1 are a series of tests with the changed amount of the liquid phosphorus compound added.

[0065]

[Reference Example 2]

Other than changing the phosphorus compound that is the fire proof agent to a solid poly phosphoric acid ammonium chloride that is the same as in the execution example 4, and changing the amount to be added to 5 weight parts in relation to 100 weight parts of soft magnetic particles, the electromagnetic waves absorbent body of the previous execution example 4 that is made of 8 layers of laminated structure of the electromagnetic waves absorbent layer of the reference example 2 was obtained. The density of the phosphorus atoms in the electromagnetic waves absorbent layer in the reference example 2 is 1.5 weight parts in relation to 100 weight parts of soft magnetic particles, which is less than the preferred density of the solid phosphorus compound. The execution example 4, execution example 5, and the reference example 2 are a series of tests with the changed amount of the solid phosphorus compound added.

[0066]

[Comparison Example 1]

MgZn ferrite with the same composition as in the execution example 1 and the same phosphorus compound were used in the same amount (4 weight parts in relation to 100 weight parts of the soft magnetic particles). For the high polymer binder, on the other hand, other than using the polyurethane resin (high polymer binder C) with the aromatic group component density of 10 weight % in the molecules with an average molecular weight of 30,000, the electromagnetic waves absorbent body of the comparison example 1 that is made of 8 layers of laminated structure of the electromagnetic waves absorbent

layer as in the execution example 1 was obtained. The density of the phosphorus atoms in the electromagnetic waves absorbent layer was also 0.4 weight parts in relation to 100 weight parts of soft magnetic particles. The density of the aromatic group component in the high polymer binder C in this comparison example 1 is lower than the density of the aromatic group component in the high polymer binder that is advocated in this invention.

[0067]

[Comparison Example 2]

MgZn ferrite with the same composition as in the execution example 1 and the same phosphorus compound were used in the same amount (4 weight parts in relation to 100 weight parts of the soft magnetic particles). For the high polymer binder, on the other hand, other than using the polyurethane resin (high polymer binder D) with the aromatic group component density of 22 weight % in the molecules with an average molecular weight of 20,000, the electromagnetic waves absorbent body of the comparison example 2 that is made of 8 layers of laminated structure of the electromagnetic waves absorbent layer as in the execution example 1 was obtained. The density of the phosphorus atoms in the electromagnetic waves absorbent layer was also 0.4 weight parts in relation to 100 weight parts of soft magnetic particles. The average molecular weight of the high polymer binder D in this comparison example 2 is lower than the average molecular weight of the high polymer binder that is advocated in this invention.

[0068]

[Comparison Example 3]

Aluminum hydroxide was used as the fire proof agent. The added amount was 12 weight parts in relation to 100 weight parts of the soft magnetic particles. Other than the change

of this fire proof agent, the electromagnetic waves absorbent body of the comparison example 3 that is made of 8 layers of laminated structure of the electromagnetic waves absorbent layer as in the execution example 2 was obtained.

[0069]

[Comparison Example 4]

Poly chloride vinyl resin (high polymer binder X) with an average molecular weight of 20,000 was used as the high polymer binder. Other than not using a fire proof agent at all, the electromagnetic waves absorbent body of the execution example 1 that is made of 8 layers of laminated structure of the electromagnetic waves absorbent layer as in the comparison example 4 was obtained.

[0070]

The high polymer binders that were used in each of the above execution example, the reference example, and the comparison example were put together in table 1.

[0071]

高分子結合剤	成 分	数平均分子量	芳香族成分含有量
A	ポリウレタン樹脂	30,000	22重量%
B	ポリウレタン樹脂	30,000	15重量%
C	ポリウレタン樹脂	30,000	10重量%
D	ポリウレタン樹脂	20,000	22重量%
X	ポリ塩化ビニル樹脂	20,000	—

1. High polymer binder
2. Component
3. Average molecular weight
4. The amount of aromatic group component contained

5. Polyurethane resin
6. Polyurethane resin
7. Polyurethane resin
8. Polyurethane resin
9. Poly chloride vinyl resin
10. 22 weight %
11. 15 weight %
12. 10 weight %
13. 22 weight %

[0072]

Also, the fire proof agents that were used in each of the above execution example, the reference example, and the comparison example were put together in table 2.

[0073]

【0073】

【表2】

難燃剤の種類	難燃剤中の濃度	状 態
燐酸エステル油脂	10 重量%	液 体
ポリ燐酸アンモニウム塩	30 重量%	固 体
水酸化アルミニウム	—	固 体

1. Types of fire proof agents
2. Phosphorus density in the fire proof agent
3. Form
4. Phosphoric acid ester oil
5. Poly phosphoric acid ammonium chloride

6. Aluminum hydroxide

7. 10 weight %

8. 30 weight %

9. Liquid

10. Solid

11. Solid

[0074]

In addition, the combination of the high polymer binders and the fire proof agents that were used in each of the above execution example, the reference example, and the comparison example were put together in table 3.

[0075]

	高分子 結合剤 の種類	難 燃 剤	
		種 類	混合量 (／微細性粒子 1 0 0 重量部)
実施例 1	A	磷酸エステル油類	4 重量部
実施例 2	B	磷酸エステル油類	4 重量部
実施例 3	B	磷酸エステル油類	3 重量部
参考例 1	B	磷酸エステル油類	2 重量部
実施例 4	B	ポリ磷酸アンモニウム塩	7 重量部
実施例 5	B	ポリ磷酸アンモニウム塩	6 重量部
参考例 2	B	ポリ磷酸アンモニウム塩	5 重量部
比較例 1	C	磷酸エステル油類	4 重量部
比較例 2	D	磷酸エステル油類	4 重量部
比較例 3	E	水酸化アルミニウム	1 2 重量部
比較例 4	X	-----	-----

1. Types of high polymer binders
2. Fire proof agents
3. Types
4. Amount mixed (/ 100 weight parts of soft magnetic particles)
5. Execution Example 1
6. Execution Example 2
7. Execution Example 3
8. Reference Example 1
9. Execution Example 4
10. Execution Example 5
11. Reference Example 2
12. Comparison Example 1
13. Comparison Example 2
14. Comparison Example 3
15. Comparison Example 4
16. Phosphoric acid ester oil
17. Phosphoric acid ester oil
18. Phosphoric acid ester oil
19. Phosphoric acid ester oil
20. Poly phosphoric acid ammonium chloride
21. Poly phosphoric acid ammonium chloride
22. Poly phosphoric acid ammonium chloride

23. Phosphoric acid ester oil

24. Phosphoric acid ester oil

25. Aluminum hydroxide

26. 4 weight parts

27. 4 weight parts

28. 3 weight parts

29. 2weight parts

30. 7 weight parts

31. 6 weight parts

32. 5 weight parts

33. 4 weight parts

34. 4 weight parts

35. 12 weight parts

[0076]

The measurement results of the electromagnetic waves absorbent body in each of the above execution example, the reference example, and the comparison example were put together in table 4. The measuring of the electromagnetic waves absorbent characteristic was done by the neighboring electric field shielding effect measurement method, and the damping effect of the electromagnetic waves was evaluated for each frequency of 200 MHz, 400 MHz, 600 MHz, and 800 MHz. Also, the fire proof characteristic was tested 5 times by the same sample, using the UL-94 flame resistance test method (20 mm vertical burning test method), and the total burning time was measured and evaluated by separating the results into V-0, V-1, and V-2. This examining

method is explained in details in “UL94 Safety Regulation Combustibility Test of Plastic Material for the Machine Parts 5th Edition, dated October 29, 1996.”

[0077]

け」に詳述されている。

* 【表4】

	電磁波減衰効果 (dB)				UL-94 耐炎試験	
	200MHz	400MHz	600MHz	800MHz	5回試験での合計 燃焼時間(秒)	難燃性判定
実施例1	- 9.0	- 9.4	- 9.8	-10.8	0	V-0相当
実施例2	- 9.1	- 9.4	-10.0	-11.0	10	V-0相当
実施例3	- 9.1	- 9.4	- 9.8	-11.4	25	V-0相当
参考例1	- 9.5	- 9.6	-10.1	-11.0	70	V-1相当
実施例4	- 8.5	- 8.6	- 9.2	- 9.9	20	V-0相当
実施例5	- 8.8	- 8.2	- 9.2	- 9.9	42	V-0相当
参考例2	- 8.9	- 9.3	- 9.6	-10.2	70	V-1相当
比較例1	- 8.1	- 8.3	-10.0	-10.8	74	V-1相当
比較例2	- 9.2	- 9.4	-10.1	-11.0	>200	V-2以下
比較例3	- 6.6	- 7.2	- 7.8	- 7.8	25	V-0相当
比較例4	- 9.6	- 9.6	-10.3	-11.5	0	V-0相当

1.

Electromagnetic damping effect

2. UL-94 flame resistance test

3. Total burning time (seconds) in 5 tests

4. Fire proof characteristic determination

5. Execution Example 1

6. Execution Example 2

7. Execution Example 3

8. Reference Example 1

9. Execution Example 4

10. Execution Example 5

11. Reference Example 2

12. Comparison Example 1

13. Comparison Example 2
14. Comparison Example 3
15. Comparison Example 4
16. Equivalent to V-0
17. Equivalent to V-0
18. Equivalent to V-0
19. Equivalent to V-1
20. Equivalent to V-0
21. Equivalent to V-0
22. Equivalent to V-1
23. Equivalent to V-1
24. Below V-2
25. Equivalent to V-0
26. Equivalent to V-0

[0078]

It is clear from looking at [Table 4] that the electromagnetic waves absorbent body in the execution examples 1 through 5 indicates a good electromagnetic waves absorbency for each of the frequency bandwidth. Also, in the determination of the presence of fire proof characteristic, each one obtained a good result that was equivalent to V-0. Especially, the electromagnetic waves absorbent body in the execution example 1 that was an average weight amount of 30,000 and used the polyurethane resin A with 22 weight % of the aromatic group component in the molecules obtained an excellent result of 0 total burning time.

[0079]

Even if the electromagnetic waves absorbent body uses the same polyurethane resin A or B, as indicated in the reference example 1 and reference example 2, the ones with the added amount of phosphorus fire proof agent below a favorable range tend to have a slightly longer total burning time.

[0080]

Even if the same polyurethane resin is used, the comparison example 1 and comparison example 2 that use polyurethane resin C or D that has the ranges of the average molecular weight, or the aromatic group component in the molecules that are outside of the range of this invention have a much greater total burning time compared to the sample in the execution example 2 with the same added amount, despite the amount of the phosphorus fire proof agent added being within the preferred range.

[0081]

The sample in the comparison example 3 that uses the aluminum hydroxide as the fire proof agent has a good fire proof evaluation. However, in order to obtain such a good fire proof characteristic, a large amount of aluminum hydroxide needs to be added at 12 weight parts in relation to 100 weight parts of the soft magnetic particles. For this reason, the volume occupying ratio of the soft magnetic particles in the electromagnetic waves absorbent layer decreases, and the deterioration in the characteristics of the electromagnetic waves absorbency is seen.

[0082]

On the other hand, the comparison example 4 that used the poly chloride vinyl resin as the high polymer binder obtained a satisfying result for both, the characteristic of

the electromagnetic waves absorbency and the fire proof characteristic. However, it does not go with the objective of this invention in terms of the influence poly chloride vinyl resin has to the environment of the Earth.

[0083]

As mentioned above, the detailed explanations were added to the electromagnetic waves absorbent body of this invention and its manufacturing method, but these are only examples, and the invention is not limited to these execution examples at all. The types of high polymer binders can be selected as appropriate as long as the choices are within the range of the ideology of the technology in this invention. The choices of the phosphorus fire proof agents can each be changed as well. It is not even necessary to say that the soft magnetic particles, the lamination structure of the electromagnetic waves absorbent layer, or the paint application thickness and the painting methods can be changed as needed. Also, the supporting body can be changed to a box for each type of electronic equipment, other than the base body in the film type and the board type.

[0084]

[The Effects of the Invention]

As it is clear from the explanations above, according to the electromagnetic waves absorbent body of this invention and its manufacturing method, high electromagnetic waves absorbent effect can be obtained even when avoiding the usage of halogen type material for the high polymer binders.

[0085]

Therefore, by using the electromagnetic waves absorbent body, the generation of halogen during usage and disposal is prevented, and an electronic equipment that is preferred for the strategy for the environment on Earth can be offered.

[Simple Explanation of the Figures]

[Figure 1]

An outline section figure indicating the basic structure of the electromagnetic waves absorbent body in this invention.

[Figure 2]

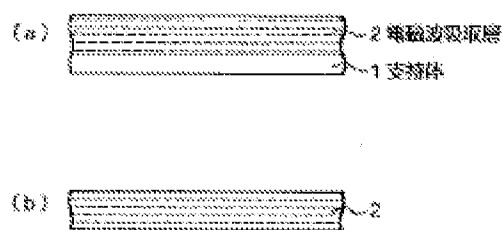
An outline section figure indicating the example of the electromagnetic waves absorbent body in this invention that is in a laminated structure.

[Explanation of the Symbols]

1 – supporting body

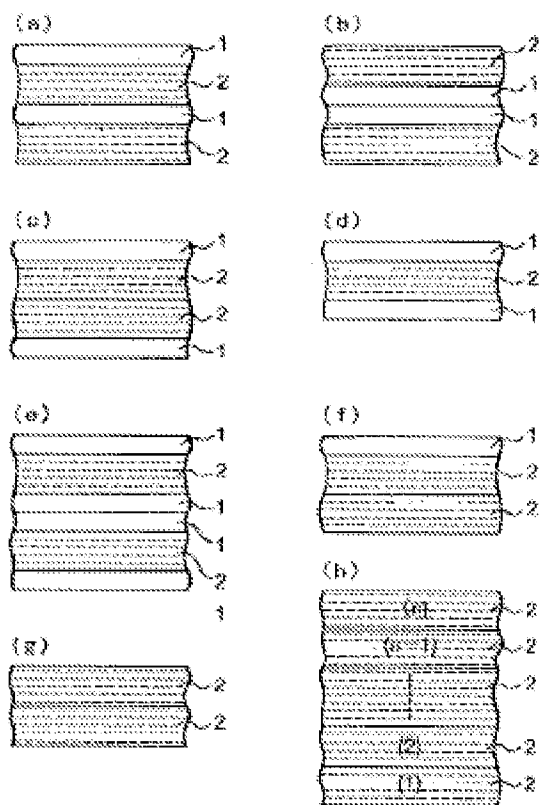
2 - electromagnetic waves absorbent layer

【图1】



[Figure 1]

【图2】



[Figure 2]

Continuation of the front page